



2ND SEM. 2014/15

FSNT 205 (S)

**UNIVERSITY OF SWAZILAND
SUPPLEMENTARY EXAMINATION PAPER**

**PROGRAM : BACHELOR OF SCIENCE IN FOOD SCIENCE,
NUTRITION AND TECHNOLOGY YEAR II**

COURSE CODE : FSNT 205

TITLE OF PAPER : PRINCIPLES OF FOOD ENGINEERING

TIME ALLOWED : TWO (2) HOURS

**INSTRUCTIONS : ANSWER QUESTION ONE (1) AND ANY OTHER
TWO (2) QUESTIONS.**

**DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY
THE CHIEF INVIGILATOR**

QUESTION 1 |COMPULSORY|

- (a) A canned food is thermally treated at 120°C to reduce the initial microbial load which was 1000 per can. The decimal reduction time (D) of the target microorganism at this temperature was found to be 1.5 min. If the probability of survival of the organism is targeted to be one in ten million cans of products, calculate the time required to reach at this probability. (15 Marks)
- (b) Calculate the rate of heat transfer through a composite wall of a cold store made of concrete lined with an insulation layer with 6 m² surface area. The insulation and concrete have thickness of 10 cm and 15 cm, respectively. The temperature on the two sides of the composite wall is 10 °C and 25 °C. The thermal conductivity of the insulator is 0.07 W/m°C and that of the concrete is 0.5 W/m°C. The system is at steady state. (15 Marks)
- (c) Orange juice flowing through a pipe at a rate of 40 kg/min is sweetened by adding concentrated sugar solution (25 % sugar) to the pipe line at constant rate. At what rate would the concentrated sugar solution be added to provide 12% sugar in the product? (10 Marks)

[TOTAL MARKS = 40]

QUESTION 2

- (a) Compare and contrast single and multiple effect evaporation system. (15 Marks)
- (b) Explain the constant and falling rate drying periods. (15 Marks)

[TOTAL MARKS = 30]

QUESTION 3

- (a) Explain the following: (20 Marks)
- i. Lag phase
 - ii. Retort come-up time
 - iii. Semi-continuous (fed batch) system
 - iv. Refrigeration load
- (b) Explain what pressure-enthalpy chart is and its use. (10 Marks)

[TOTAL MARKS = 30]

QUESTION 4

- (a) Name the components of a refrigeration system and give three (3) purposes of refrigeration in the food process operation. **(15 Marks)**
- (b) With the help of a sketch show a heating process on the psychrometric chart and describe the changes in the property of the air. **(15 Marks)**

[TOTAL MARKS = 30]

Relationships $f_h/U: g$ for Values of $z = 10^\circ \text{C}$

f_h/U	Values of g ($^\circ\text{C}$) when j is:								
	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
0.2	2.27×10^{-5}	2.46×10^{-5}	2.64×10^{-5}	2.83×10^{-5}	3.02×10^{-5}	3.20×10^{-5}	3.39×10^{-5}	3.58×10^{-5}	3.76×10^{-5}
0.4	7.39×10^{-3}	7.94×10^{-3}	8.44×10^{-3}	9.00×10^{-3}	9.50×10^{-3}	1.00×10^{-2}	1.06×10^{-2}	1.11×10^{-2}	1.16×10^{-2}
0.6	4.83×10^{-2}	5.24×10^{-2}	5.66×10^{-2}	6.06×10^{-2}	6.44×10^{-2}	6.83×10^{-2}	7.28×10^{-2}	7.67×10^{-2}	8.06×10^{-2}
0.8	0.126	0.136	0.148	0.159	0.171	0.182	0.194	0.205	0.217
1	0.227	0.248	0.269	0.291	0.312	0.333	0.354	0.376	0.397
2	0.85	0.92	1.00	1.07	1.15	1.23	1.30	1.38	1.45
3	1.46	1.58	1.69	1.81	1.93	2.04	2.16	2.28	2.39
4	2.01	2.15	2.30	2.45	2.60	2.74	2.89	3.04	3.19
5	2.47	2.64	2.82	3.00	3.17	3.35	2.53	3.71	3.88
6	2.86	3.07	3.27	3.47	3.67	3.88	4.08	4.28	4.48
7	3.21	3.43	3.66	3.89	4.12	4.34	4.57	4.80	5.03
8	3.49	3.75	4.00	4.26	4.51	4.76	5.01	5.26	5.52
9	3.76	4.03	4.31	4.58	4.86	5.13	5.41	5.68	5.96
10	3.98	4.28	4.58	4.88	5.18	5.48	5.77	6.07	6.37
20	5.46	5.94	6.42	6.89	7.37	7.84	8.32	8.79	9.27
30	6.39	6.94	7.56	8.11	8.72	9.33	9.89	10.5	11.1
40	7.11	7.72	8.39	9.06	9.72	10.4	11.1	11.7	12.4
50	7.67	8.39	9.11	9.83	10.6	11.3	12.0	12.7	13.4
60	8.22	8.94	9.72	10.5	11.2	12.0	12.7	13.5	14.3
70	8.67	7.78	10.2	11.1	11.8	12.6	13.4	14.2	15.0
80	9.01	9.89	10.7	11.6	12.3	13.2	14.0	14.8	15.6
90	9.44	10.28	11.2	12.0	12.8	13.7	14.5	15.3	16.2
100	9.78	10.7	11.6	12.4	13.3	14.1	15.0	15.8	16.7